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“Without libraries what have we?”

Public libraries as nodes for technological empowerment in the era of smart cities, AI and big data

*“Without libraries what have we? We have no past and no future.”

–Ray Bradbury

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ABSTRACT

Since 2014, a growing body of critical research has pointed out flaws in smart city development. It has been described as too technology-led and business-oriented, diminishing citizens’ agency and causing digital divides. As the agenda keeps spreading, there is an urgent need to develop more participatory, inclusive and bottom-up approaches to balance interests of those currently in strong power positions, such as large corporations. Participatory design (PD) and participatory approaches in general have been suggested as a remedy, but they often tend to be local, small-scale and short-term. Therefore, their impacts are often modest as well. We suggest that we need to start thinking about ways to create scalable approaches that would grow the temporal and spatial impact of actions and practices that intend to increase citizens’ understanding and control over new technologies, i.e. their technological agency. Without making sure that more people have adequate knowledge and sufficient control and mastery of technologies, societal discussion and ultimately, political decisions, are left to few experts. We explore the potential of public libraries to act as an ally and cooperation partner in participatory design and technology education in general, with a significant potential to broaden micro-level actions’ impact.

The paper consists of a broad literature review mapping the central challenges of current smart city development; this is followed with an introduction to the Finnish library system as a democratic project; finally, we present three examples of how libraries are carrying out technological education connected to emerging technologies, particularly to 3D printing, robotics and virtual reality. Our central argument is that there is a need to bridge micro-level actions, such as those connected to participatory design projects, with the macro-level techno-political development by collaborating with meso-level actors and networks.

CCS CONCEPTS

• **Human-centered computing ~ Participatory design** • Human-centered computing ~ HCI theory, concepts and models • Social and professional topics ~ Computing literacy

KEYWORDS

Smart city, participatory design, artificial intelligence, big data, public library, makerspace, transdisciplinary collaboration

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1 INTRODUCTION

During recent decades, the “smart city” (can be abbreviated as SC) as a framework for developing cities has turned into a global phenomenon [28, 14, 21]. According to the smart city agenda, new technologies, especially digital technologies, can be used to coordinate, rearrange and enhance life in cities on many levels. Often it is also connected to economic success and the environmental sustainability of cities. [49, 51] This agenda already affects the lives of tens of millions of people; for instance, some Asian and Arabic countries are building entire new cities based on the smart city concept (Masdar City in United Arab Emirates, New Songdo City in South Korea). Estimates regarding the number of smart cities globally vary, also due to the differing definitions that are given to the concept. However, according to a report by the

European Union [32], there are currently over 240 cities in Europe that have made progress towards becoming "smart". In Finland, especially the cities of Helsinki and Oulu have adopted the agenda, and many others are following suit.

For urban inhabitants, smart city developments promise wealth and wellbeing but they pose also a number of problems, identified by researchers and presented in more detail in the next chapter. One of the central critiques is the question of whether the smart city is, in fact, primarily a business-led and technology-centered top-down agenda, promoted by and benefiting mostly companies. Rather than benefiting all urban inhabitants, then, the worry is that smart city developments increase inequalities in cities, including the digital divide [38]. This point is acutely highlighted in the literature that scrutinizes the business models of ICT industries in the era of Big Data and Artificial Intelligences (AIs). The lifeblood of these technologies' business model is a never-ending stream of monetizable data, extracted from users in both opaque and transparent ways [58]. Most of the smart city critique that has been presented agrees that there is a need for inclusive, activist, participatory, democratic and/or bottom-up approaches to balance the interests of businesses and governance authorities. Furthermore, it has been argued that technological environments should be designed in a way that increases their users' agency rather than diminishes it, transferring it to intelligent technologies [54]. However, there is a dearth of research on the actual, grass-roots, hands-on ways of doing this work, especially in a scalable manner.

Consequently, we propose that public libraries can act as non-commercial nodes of physical and digital spaces that can also take on the role of educating the public about the importance of urban technology making, and help citizens better understand these changes in society. Furthermore, they can also act as nodes of participatory and democratic design in societies, including the design of urban technologies. Although libraries are not often conceptualized as a part of a smart city, we claim they can and should occupy a central role. Finland acts here as our prime example. The Nordic country has exceptionally strong network of public libraries that are also highly valued and frequently used by its citizens [50, 37]. According to the Finnish library legislation [17], public libraries are obligated to educate citizens on new technologies; through this work, libraries are expected to support democracy and equality. We introduce examples that demonstrate how public libraries in Finland are currently carrying out this task. These include a library makerspace with diverse events and workshops, and a transdisciplinary technology design process that bridged library patrons, library staff and university researchers by utilizing design anthropology and participatory approaches to design. Further, we claim that in a Nordic democratic society, smart cities could potentially grow into something that actually resembles the alternative models presented in critical SC literature. More inclusive, participatory and democratic smart cities could be created by utilizing and reinforcing existing societal programs.

This paper is a theoretical piece that intends to conceptualize how flaws in smart city development could be addressed in practice. To strengthen our position, however, we also introduce previously conducted and ongoing empirical work that highlights the potential of the library system in creating societal impact, and argue on behalf of joining forces with this network. We claim that in a democratic society it is of crucial importance to inform citizens and increase understanding of the effects of new technologies in general and the digitalization of cities in particular. Furthermore, it is equally important to promote participatory ways to create and design new technologies, and more broadly, our techno-urban futures. This includes spreading models of thought that highlight more active stances towards the future. Societal changes must be openly discussed and, hopefully, metabolized in a democratic and equitable manner.

Overall, this paper navigates between macro-level views and micro-level approaches; **the intention is to bridge these two levels and study the possibility and potential of meso-level actions as a design space.** In this case, meso-level is enabled by public libraries and the network they constitute. Our work is in early phase, and one the purposes of this paper is to introduce the scope of our ongoing research.

2 USING SC CRITICISM TO CREATE MORE DEMOCRATIC SC PRACTICES

In the following, then, we attempt to relate our work to existing smart city literature in a multi-level manner, from the macro scale to the micro, in order to consider the effects of the phenomenon on citizens' agency. There are hundreds of smart city initiatives in the world today, yet the exact nature of smart cities and the smart city agenda is very difficult to define [28]. Smart cities can be found everywhere in the world [14, 39, 53], and generally, they can be described as being urban areas which are being purposefully infused with digital technologies and infrastructures. However, there is no consensus regarding what aspects would constitute its hallmarks – for instance, what policies, services or infrastructures it should have and what its aims should be. This state of affairs seems to be connected to the origins of the smart city agenda as a corporate narrative [49]. The smart city vision has been largely crafted by large providers of smart city technologies, such as IBM, Cisco and Deloitte. These corporations offer their smart city services as solutions to urban challenges such as rapid urban growth, competition between cities, economic constraints, and sustainability. The city is often seen as a platform for these companies' technologies on which services are provided and data harvested. Through this model, many aspects of urban life would be altered; Deloitte, for example, envisions on its website that "the role of government shifts from 'doing things' to enabling participation in civic innovation." Also, "with the growing ubiquity of wearable and connected devices, citizens can co-create data itself." In fact, these companies foresee a wholesale digitalization of the urban infrastructure and the birth of new ones: From smart workers, meters, security, mobility, citizen experience, infrastructure management and open data to citizen experience. [15, 11]

Given the all-encompassing nature of these visions, then, the question necessarily arises regarding how exactly these alterations would affect the everyday life of citizens, and whether

or not citizens might have any agency in these developments, as individuals and as part of a civil society. Indeed, these developments have given rise to a whole literature of smart city critique that focuses on the business-led and technology-led nature of these developments [22, 9, 49] and the business models of ICT in general. These seem to revolve around the tightly entangled dynamics of data (its collection and use), privacy, inclusion and economics. These are given rise by what Zuboff [57, 58] has called the *informating* quality of digital technology; the ability of digital technologies to produce information about its own use and thus its user. Analogue technologies, while being able to automate tasks, are not able to informate in any significant way. This simple fact renders digitalized urban environments hotbeds of data production. What happens when the whole urban environment begins to informate, i.e. to produce data about its use and status – and how will this affect citizens' right to public spaces and privacy – is an open question of crucial importance.

2.1 SC as platform of data harvesting

Thus, smart cities can be seen as method of altering cities into landscapes where big data can be harvested. The notion of cities as platforms [15, 11] ties in strongly with the idea of big data, i.e. incomparably large datasets used to analyze and predict user behaviors [e.g. 6, 10]. Considering the work of Zuboff, the rise of big data can be seen as connecting with the post dot com bubble era business logic of large companies such as Google and Facebook. According to Zuboff [58], after its near-collapse in the dot com bubble, Google dramatically changed its business practice, relying consequently on extracting data from users, almost like a natural resource, as its method of creating revenue. This practice was soon brought to Facebook via the hiring of a former Google executive. Now, this model is the primary business model of the computer-mediated world anywhere the global market exists. The aftermath of these developments, then, is the creation of a novel form of capitalism, dubbed surveillance capitalism by Zuboff [58]. Against this background, Deloitte's [15] vision, where citizens become "co-creators of big data" in smart cities, becomes a subject of intense interest. Is it feasible to suggest that citizens truly have the right to also *not* "co-create" data while they conduct their lives in smart cities? Are they entitled to own their data? What are the underlying concepts regarding citizenship and citizens' agency that underlie these visions?

2.2 Citizenship and citizens' agency in SCs

This has been the subject of scrutiny of Cardullo and Kitchin [9], who argue that the smart city agenda can be seen as a part of neo-liberal urban planning; or, that smart city agendas "enact a blueprint of neoliberal urbanism and promote a form of neoliberal citizenship" [9]. According to Peck at al. [42], neoliberal urbanism can be described as a model of urban growth that is based on marketization: the "subordination of place and territory to speculative strategies of profit-making at the expense of use values, social needs and public goods". In this model, the market arranges services, infrastructure, housing, public space and other resources. The smart city agenda, thus enables businesses to further capture public assets and services by offering technological solutions to urban problems. The citizenship that neoliberalism argues for is centered not around various inalienable rights, but on individual autonomy, freedom of choice and personal responsibilities [e.g. 9, 51]. However, access to various services and products is only attainable through a select few commercial providers, making the "choice" in practice quite illusory. Indeed, we can argue that this freedom of choice is paradoxically thrown into question by the very business practices of big IT: predicting user behavior through big data, persuasive technologies [18], and simply, by traditional marketing, which all specifically, and successfully, modify individuals' behavior. We will attest that if all citizens really were such independent actors with autonomy and truly free will, these strategies would not work. Kitchin and Dodge [29] have argued that software is seductive because it promises rewards for use, but at the same time it conditions through automation and forms of control. This may also affect decision making processes, as data analytics, sensing and media intertwine with ever more powerful artificial intelligence technologies (AIs), possibly circumventing public discourse and democratic systems. [9]. Overall, then, Isin and Ruppert [25] argue that there is a need for digital citizens to possess a suite of digital rights. To this notion we would add that there is a need for citizens to also be able to build technological empowerment and sense of agency through skills and awareness. As changes in digital technologies are incredibly rapid, it becomes a central citizenship skill in a democratic society for citizens to learn about technological developments continually and at every life stage.

2.3 SC dataveillance in the era of AI

A further development affecting citizenship in smart cities is the ability of smart city technologies to further enable surveillance and dataveillance. Dataveillance is "the systematic monitoring of people's actions or communications through the application of information technology" [12, 13]. This aspect is heightened in the rapidly advancing era of AIs that enable far beyond human level analysis and utilization of data. While the idea of dataveillance can be seen as being connected with surveillance capitalism, it is not inherently tied to any societal or economic model. China has taken a different route and is in the process of developing a state-led AI surveillance society, by using AI face recognition algorithms, cameras and sensors. Any major nexus of mobility, such as train stations and airports, are especially prone to being thus equipped. These can monitor not only wanted criminals, but also ordinary citizens' minor offences, such as jaywalking. Between 2018–2020, China is also introducing the new social credit system, which identifies every citizen through an individual number, connected to a permanent record that calculates a citizen ranking; with a bad record, private loans and even traveling may be impossible. While many of the technologies that China has invested in do not work yet exactly as planned or do not have a large coverage, the will to create an algorithm-governed society seems to exist. Global IT companies are very interested in this new market. [36, 16, 45, 30]. It is most likely then, that these dataveillance practices will be used in any way, and to any extent,

that is allowed by the prevailing notions regarding legislation, overall economic model and society at large, creating a double-edged sword. Whatever the societal model, then, these technologies already seem to have a large effect on citizens' rights.

2.4 A need to address SC criticisms on macro, meso and micro levels

The critical scholarship on smart cities has resulted in the creation of new kinds of macro-level governance or collaboration models in smart city scholarship. Many smart city developments rely, and have relied on, the interplay of government and the private sector [8], or the so-called triple helix model of innovation of Leydesdorff and Etzkowitz [31], which focuses on the interactions between academia, industries and governments. However, more comprehensive models have since been developed that recognize the importance of the third sector. These are sometimes referred to as the quadruple helix or the penta helix model. The quadruple helix treats the third sector as one part of the helix, whereas the penta helix nomenclature makes a separation between certain third sector actors, e.g. the civil society and social entrepreneurs in the penta helix model of Calzada [7]. However, these macro-level models naturally do not address the issue of how exactly this should be done.

These new smart city models, then, identify the civic society, i.e. private citizens, activists, enthusiasts, the media and the third sector at large, as key players on the macro-level. On the micro-level, we argue that this necessitates the inclusion of participatory practices in smart city development. Thus, we need ways of city-making that balance and even oppose these forces. McFarlane and Söderström [34] have suggested some guidelines for making 'alternative smart cities'. They claim that "alternative [smart urbanism] can be generated through foregrounding smart in the lifeworlds of different marginalized groups in the city" and that "place-based, experiential and largely neglected urban knowledges of residents in precarious contexts". Academics, they argue, should engage in "the further development of public urban studies that co-produce knowledge with citizens and particularly with marginal groups as well as the reconstruction of alliances between urban studies and urban planning, two worlds that have drifted apart in many countries." This would necessitate micro-level approaches that engage various kinds of stakeholder groups and individuals. We agree that these hands-on, grassroots approaches are necessary; however, as Mariën and Prodnik [33] argue, these micro-level approaches are not unproblematic:

Citizen-centred initiatives tend to ignore the social, economic, political and technical conditions within which individual choices are made and within which individuals inevitably act. It is the wider social context that, in many ways, limits the possibilities that individuals have in digital environments. (…) It also remains difficult for most individuals (…) to have a defining influence on the operational characteristics of the key platforms they use online today, to be fully included in the public life via the Internet or to be empowered in the sphere of politics. (…) It is especially difficult for users – and even groups of users – to go against the logic under which the Internet has developed in the recent decades. [33].

Against the immensity of the underlying policy and business models that drive digitalization in society, then, the participatory approaches could be seen as impotent and potentially even harmful, tokenistic practices if they mask the real lack of democracy and equity that has been built into the economic logic that drives the phenomenon of smart cities [e.g. 9]. A truly sustainable approach to digital inclusion, then, should also address the macro, meso and micro level, with the objective of harmonizing them. Thus, designers should strive for scalable actions that take their cue from inclusive public policy that would strive for the digital inclusion of all, including "the low-educated, the non-motivated, the low-skilled and the non-users" [33] and to go beyond the often ad-hoc character of user-centric bottom-up approaches. This, then, should be the guideline not only for public policy but also for design activities. In order for user-centric design activities to be scalable, a meso-level is also needed. Macro and meso level social inclusion legislation and programs naturally vary from country to country; but overall, it can be seen as a potentially viable strategy to combine digital inclusion with other social inclusion structures at various levels. Next, we will briefly report on the social inclusion legislation that has driven the Finnish library system, and how digital inclusion as a policy is already a part of this legislation.

3 FINNISH CONCEPT FOR PUBLIC LIBRARIES

In the following two sections, we move from macro to micro level and towards meso-level actions. Firstly, we aim to describe how Finnish public libraries have been a rather successful democratic project, which, due to its scale, could act as a societal counterforce to the undemocratizing tendencies of smart city development. Secondly, we explain what kind of micro-level work has already been done in Finnish libraries to enhance citizens' technological agency, and reflect on 1) how this could be linked with the aims of PD scholars and 2) how these joint actions can be scaled up to form networks that we understand here as meso-level actors.

Finnish public libraries have been acting as central nodes for technology education since the 1990s. This is connected to the larger agenda and position of libraries which have their roots already in the 19th century: the library institution's mission was to support equality and democracy. In contemporary Finland, libraries are seen as democratic, low-threshold, non-commercial urban arenas for every citizen. All kinds of library services are free of charge. The libraries' public image is very positive, and citizens consider them as respected cultural institutions. In 2017, libraries were visited 50 000 million times, and on average, every Finn visited the library 9 times [41]. Within the European Union, Finns are the most active library users [4].

Public libraries and their versatile services have gained also global attention, and Vakkari et al. [50] state that Finnish public libraries are among the forerunners in the whole world (see also [23]). The library institution's status in society is nicely exemplified by *Oodi* (Fig. 1), the new central library that opened its doors in December 2018 in the capital city Helsinki. The construction of the architecturally impressive building cost 98

million euros, and it has been featured in the *New York Times* among other global media [47]. It has books to borrow as any conventional library, but at the same time, it boldly intends to be a co-working space and a makerspace, as we will detail below.

The fact that such a massive central library was realized reflects the current financial situation of public libraries in Finland, where, compared to many other countries, libraries are relatively well funded. Vakkari et al. [50] conducted a comparison between public libraries in three Northern European countries of approximately the same size: Norway, Netherlands and Finland. They found out that Finland has higher operational costs, longer opening hours, and more professional librarians than libraries in the two other countries. However, the same study also demonstrated that Finnish citizens perceive they are getting significantly more benefits from their libraries than Norwegians and the Dutch. Perhaps not surprisingly, the resources and the level of services affect perceived benefits clearly. Furthermore, in a more recent National Library Survey carried out in Finland in 2018, 43 % of 28.000 respondents thought public libraries enhance their quality of life "very much"; 42 % ticked the second option stating libraries have enhanced their lives "relatively much" [37].

Figure 1: New central library *Oodi* in Helsinki, Finland. Photo: Tuomas Uusheimo © Helsinki Central Library Oodi.

The objectives of the public libraries in Finland are defined in the current Public Libraries Act (1492/2016) [17] which became into effect in 2017:

(1) The objectives of this Act are to promote:

1) *equal opportunities for everyone to access education and culture;*
2) *availability and use of information;*
3) *reading culture and versatile literacy skills;*
4) *opportunities for lifelong learning and competence development;*

(2) active citizenship, democracy and freedom of expression.

The implementation of these objectives is based on sense of community, pluralism and cultural diversity.

Overall, especially the newest version of the legislation defines libraries as sites that provide people means to participate in societal discussions as active citizens. Education is not seen only as a value in itself but it enables active citizenship and is a prerequisite for all action. This educational objective includes also an obligation to educate citizens about new technologies. In our previous work [20] we interviewed high-level administrative personnel of a Finnish library, one of whom stated that

Public libraries have provided IT education for a long time [- -] nowadays the idea is not just to educate people about elementary technologies but to offer citizens a possibility to familiarize themselves with new phenomena which are not yet necessarily part of everyday life. In a democratic society, everybody should have a chance to also try out technologies they cannot afford or they do not want to acquire for other reasons.

Thus, libraries intend also to diminish the digital divide in Finnish society [see also 50].

In the public libraries, education on digital technologies began in the 1990s, when libraries across the country started to offer access to the Internet and computer courses. Famously, *The Bill and Melinda Gates Foundation* granted a prize of one million dollars to the City Library of Helsinki for increasing citizens' possibilities to use the Internet. Currently, public libraries in Finland offer courses and workshops about new digital technology as well as seminars and lectures. At the time of writing is article, the event calendar of the libraries of the capital region of Finland included, for example, "Digital guidance for seniors"; "IT-workshop cafe", "Robot workshop"; "Easy 3D modelling"; and "AI Monday" (events between 30 Jan–11 Feb 2019). High-tech devices can also be borrowed and utilized for different purposes. The offerings of the new central library Oodi include tablet computers, 3D printers, a laser cutter, computerized embroidery machines, and equipment to digitally sculpt wood; in addition, it offers complete spaces furnished with different technologies such as a recording studio, a gaming room with consoles, and an immersive 3D space. The leap from providing access to and courses on desktop computers and the Internet in the 1990s is enormous – but so has been the pace of technological development during the last 30 years.

Research literature confirms that empowering encounters with new technologies are needed in order to enhance citizens' overall understanding of technologies' impact, possibilities and challenges, and to increase technological agency [e.g. 1, 24, 54]. Only increased comprehensive understanding and experiences of one's capabilities and control over technology can create space for critical perspectives. Furthermore, it is crucial for everybody to realize that the direction of our technological futures is not fixed but that we do have a choice; learning participatory and collaborative ways to create an impact can also be seen as a part of a larger cultural change that is needed in order to democratize the making of our techno-urban futures [e.g. 3, 46, 55]. This is becoming more and more relevant as digital technologies are embedded in everyday life in increasingly sophisticated, invisible and complex ways; we should not even discuss them as a separate entity but consider them as sociotechnical systems surrounding us [2]. Nevertheless, as Warschauer [52] notes, granting access to technologies is not enough to diminish the digital divide – or, more broadly, digital inequalities – or to increase technological

agency; in addition, there is a need for *relevant content, literacy and education* as well as *institutional and societal structures* that support the use of physical resources. It can be claimed that public libraries encompass all these resources.

4 FROM MAKERSPACES TO TRANSDISCIPLINARY COLLABORATION

Next, we describe in more detail some Finnish libraries' activities connected to technology education and technological empowerment of the citizens. Accordingly, we focus on the micro-level here. In addition, we speculate how these activities can be connected with the aims of PD scholars. We present two different locations and three library events or cases focusing on emerging digital technologies: 3D printing, robotics and virtual reality (VR). As our work is ongoing and in a relatively early state, the descriptions are based on differing materials and vary in depth; nevertheless, we consider they illuminate the breadth of libraries' activities and multi-layered potential embedded in these encounters between people and technologies.

4.1 Library makerspace "Ompun Paja"

We first present briefly Library makerspace *Ompun paja*, located in the Library Iso-Omena (engl. 'big apple') in the capital region[1] (City of Espoo). The location of the library is interesting in itself: it can be found at the highest floor of a large shopping mall, where it forms a service center together with diverse health services, youth services and social services. This makes it easy to approach and visit when running errands. Last year, the Library Iso-Omena was the most popular library in Finland, attracting approx. 1.350 000 visitors. According to the staff, the makerspace has thousands of visitors every month, and feedback is mostly positive; nevertheless, feedback has not been collected systematically.

The makerspace gained a lot of media visibility in the spring of 2018, when it arranged an "Alternative Valentine's Day". The event in question was a singular event, targeted for all citizens – except for the makerspace that was reserved only for adults. The program included presentations on sexuality, relationships and mythology, but for the purposes of this paper, the most interesting feature were activities carried out in the makerspace that involved 3D printing of the clitoris. Anatomically correct printed models could also be decorated with glitter, for example. These activities were highly popular and received good feedback according to the interviews given to popular media, and they are intriguing also from a research perspective: First of all, a new technology was introduced to participants of the event through an appealing theme which, presumably, increased its empowering potential and made easier for participants to approach new technology. Following Warschauer [51], relevant content is an important aspect of increasing people's technological agency. In addition, the event was empowering also from the perspective of female sexuality; it made something invisible visible (as large part of the clitoris is hidden inside the body and many people do not realize its size), creating representations that celebrated an organ connected to pleasure. Secondly, the event gave birth to interesting media discourses: popular articles published by leading national media companies [e.g. 26, 27] and related comments, for example, in social media, pondered the drastic change of Finnish libraries from bastions of literature to high-tech co-creation spaces. The media discussions reveal that the change also causes friction, and a part of the population is afraid that literature will not be the focus of libraries in the future. However, some celebrate the transformation and see nostalgia and old-fashioned views of libraries posing a threat to the institution's future as they prevent citizens from taking full advantage of libraries' new offerings. Clearly, studying these media discussions would comprise a research theme in itself.

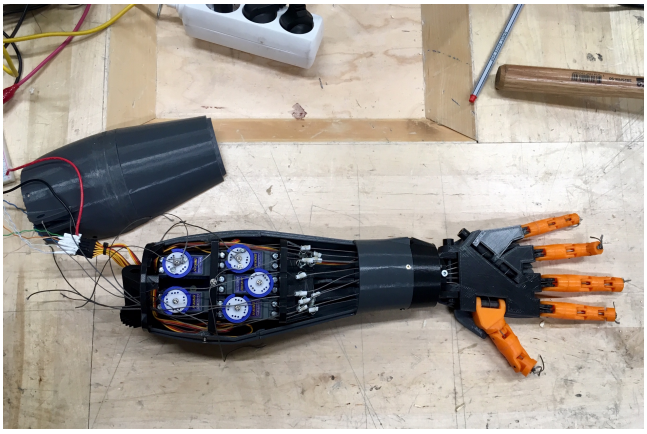

Figure 2: Hand of the InMoov robot. All parts are 3D printed and assembled in the Robot workshops of *Ompun paja* makerspace. © Johanna Ylipulli.

The second activity we shortly present here took place in Ompun paja as well, in the spring of 2019. We made a field visit and conducted some participatory observation in a *Robot workshop*, including informal discussions with the staff of the makerspace and visitors. The Robot workshop is a continuous workshop, held once every month, with the purpose of collaboratively building an InMoov[2] robot (Fig 2.). The robot itself is an open-source 3D printed humanoid robot designed in France. Even at first glance, the diversity of workshop participants was evident: they belonged to several different ethnic groups and consisted of both adults and children, males and females. Nevertheless, men and boys made up the majority, which was confirmed by the staff of the makerspace. The staff also told us that during the workshop, they use both Finnish and English due to the diversity of participants, and offer also child-specific activities by utilizing Lego robots. It was also reported to us that some workshop participants were very committed and showed up every time. During our visit, the diversity of participants appeared

[1] The capital region on Finland consists of the central cities of Helsinki, Espoo, Vantaa and Kauniainen. It has approx. 1.17 million inhabitants.

[2] http://inmoov.fr/

almost as a democratic utopia; nevertheless, we consider the smaller number of women and girls problematic.

In the libraries of the City of Espoo, the makerspace activities began already in 2013, and currently there are five such spaces in different libraries. The staff at Ompun paja told us that their emphasis is currently on community building, sustainable development and digital support services, following the wishes of library patrons. They also often connect makerspace activities with other library content, as was the case with the Alternative Valentine's day; they have had Harry Potter and Star Wars events too. Consequently, they have established *concepts* around makerspace activities; and they have a *whole network of well-established, completely open spaces with support staff available.* Naturally, the interactions happening during the events and workshops beg for further research, as well as the experiences of the participants and the experienced impact of different activities.

Nevertheless, these brief glimpses highlight that library makerspace activities hold great potential in empowering citizens and in enhancing their understanding of new technologies. Moreover, the activities seem to support inclusion, participation, and multicultural and multigenerational encounters. In general, these activities seem to be in line with many aims and values embedded also in PD and related approaches which would make libraries natural allies. Next, we reflect on how PD scholars can collaborate with libraries in practice by presenting a third case, which is one of our own projects.

4.2 Transdisciplinary co-design process in a library context

The third activity we introduce took place in a different part of the country, in the city of Oulu, located in northern Finland. This case is somewhat different as it was a transdisciplinary co-design process, carried out as a collaboration between the City Library and the University of Oulu. We ourselves played central roles in the project by designing and leading participatory design activities. The goal of the project was to produce a functional, immersive *Virtual Reality prototype for a public library* by utilizing principles of participatory design, PD [5, 48]. At the same time, the aim was to study the design process itself and develop PD methods [56], and scrutinize how people experience and perceive the impacts of virtual reality environments, such as the merging of digital and physical public spaces. We explain the whole process here very briefly; more detailed accounts can be found in [35, 44].

The process began in 2016 when we conducted a preliminary interview with the library administration and probed their interest in such collaboration. This was followed with two multi-stakeholder workshops with library staff, library patrons and researchers for creating ideas and gathering specifications for the VR prototype (Fig 3.). After the first workshop (35 participants) we created some virtual reality environments based on the initial ideas; in the second workshop (17 participants) the participants tried out these spaces and developed the service ideas further with us. The concept for the virtual library and its services was based completely on the ideas that came up in the workshops. Further, in the fall of 2017 we conducted user evaluation with twelve participants who had participated also in the PD workshops and polished the prototype according to their experiences and feedback. At the moment the Virtual Library is publicly available for everybody at the premises of City library [20].

Figure 3: Workshop participant's vision of Virtual Reality library, including a fantasy forest and a book store. © Johanna Ylipulli.

We consider the whole process of designing a virtual library as an interesting example of a transdisciplinary participatory design process that was deeply embedded into the technology education agenda of public libraries. The project operated on multiple levels and offered differing returns to different stakeholders involved. First of all, the PD process we utilized resulted in the following: 1) workshop participants learned about technology design processes and the technologies in question (VR especially) which at least began to open up the "black box" of technology design; 2) the design process itself intended to be democratic, and the designed technology artefact is based on multiple voices which, according to our research results, made it pleasant and usable for the target community [20, 44]. Nevertheless, the number of PD workshop participants was limited, and therefore, we cannot argue that the impact was very broad. Therefore, concerning our arguments in this paper, it is crucial that the end product (virtual reality library) continues to be on display and in use at the library. There, it can act as an artefact that further increases citizens' knowledge of new technologies – demonstrating the scalability potential embedded in the library context. The digital artefact itself is also an important return for the library; from the start we promised that the library can use the prototype for its own purposes. Finally, through researching the process, we were able to gain and disseminate knowledge of how citizens encounter and experience new VR technology and how they would like to use them, to the benefit of policy-makers and non-participating citizens. This spreads the impact of the project further across several sectors of society, as per the quattro or penta helix models.

The Virtual Library is also an example of the scalability that national public library network enables: The city of Vantaa, located also in the capital city region, has been creating its own

Virtual Library in collaboration with a VR company at the same time when the previously described project was accomplished. Originally these were two independent projects, but currently the libraries intend to bridge them, in collaboration with two universities and the VR company. The goal is, first of all, to combine these two virtual libraries in order to build a broader virtual environment for public use; second, the intention is to acquire more VR gear for libraries so that they could display VR worlds; and third, create practices and a manual for creating new spaces through participatory approaches for virtual library to enhance technology education and participatory practices to technology design. Thus, as a societal program with a broad reach, the library system can represent a true boon for upscaling the participatory Virtual Library that was realized as a part of a time-limited project.

5 DISCUSSION AND CONCLUSIONS

There is much astute critical literature on how the smart city agenda has been largely business and technology led. This criticism is highlighted in the era of AI, big data and surveillance capitalism that are poised to change the nature of our democracies in drastic and sometimes opaque ways. Alternative macro-level governance models that account for the third sector have been devised to address these issues. Similarly, participatory and user-centered design has attempted to address the issue of democracy and digital inclusion on the micro-level, by striving to empower individuals. However, these approaches are not well connected, and thus, we argue for a need for meso-level approaches that would combine and harmonize the macro-level models with micro-level practices. For design, the meso-level opens up relevant design space wherein novel services and technologies can be created and maintained in a participatory manner. For this potential to be realized, we argue that these digital inclusion strategies and practices should be integrated with other social inclusion programs.

The library system represents a major opportunity for participatory researchers to reach a wider audience. Libraries in many countries already offer education and experiences of emerging technologies for everybody whereas schools, for example, obviously reach only a certain segment of people. The national coverage of the library system enables researchers to collaborate with a system of non-commercial spaces, ensuring a wide access to participatory spaces and events. The users of (Finnish) libraries represent people of all ages and varying backgrounds, which is a central concern for participation in technology design and the diminishing of the digital divide. Any stakeholders forced to work within the limitations of projects also benefit from the library collaboration: libraries offer more stable structures than short-term PD projects. The Virtual Library is a prime example of this: The research project that was principally in charge of its design and development has ended, and researchers have been scattered to work in different universities. However, the libraries themselves have kept the process alive by displaying the artefact to library patrons and are currently leading a new project intending to spread the use of the artefact for educational purposes. We consider these kinds of collaborative approaches as some of the most promising ways to combat undemocratizing tendencies of smart city development. Of course, the idea is not that scholars using PD or other related approaches will just benefit from the already existing structures and networks libraries offer, but these relationships must be reciprocal. In the library context, researchers can bring added value in by adding significant depth in the micro-level participatory actions.

Therefore, our further research questions will explore the practicalities of combining the two VR library projects and their potential expansion across more libraries. Also, the potential to utilize the approach in the design and research of other important technologies, such as AIs, augmented reality, and the effects of big data and smart cities, should be explored. However, there are also more broad questions connected to the impact of libraries' technology education. The most recent survey, the National library survey 2018 [37] probing the topic revealed that only the youngest (<18 years old) and the oldest (>65 years old) respondents felt the library had significantly increased their ICT skills. There is a need to evaluate especially the most novel activities, such as makerspaces, and their impact systemically and with both qualitative and quantitative means. It also should be studied how especially the groups of people that are not conventionally interested in new technologies, such as Finnish girls [43], could be empowered through library-enabled activities. We are also interested in scrutinizing how critical and holistic perspectives that view technologies as sociotechnical systems could be emphasized and fostered in these contexts.

The applicability of this paper is limited by the fact that libraries have differing roles, positions and possibilities to act as societal power players in different countries. Nevertheless, at least in the Nordic countries library networks and the tasks assigned to them resemble each other. In addition, our conceptualizations are not limited to libraries: we believe that in different countries, similar established, networked institutions, capable of taking the role of meso-level actors, can be found. In these contexts, PD practitioners should naturally consider what institution or network would be able to provide similar coverage and benefits. In addition, it must be noted that our work is in a relatively early phase, and we have only started to explore how connections can be built between micro and macro-level actions, and what effects this might have. Further empirical work is absolutely necessary to prove that collaboration with meso-level actors can address the challenges of smart city development we have discussed.

Following the state-of-the-art critical literature, the smart city agenda seems to be a battlefield between either a neoliberal, surveillance capitalist or a totalizing state-led dataveillance society. In both cases, the future of democracy and civil rights are called into question. Thus, it is necessary to develop more tempered smart city models and practices. These must be built on a basis of public education, public participation, and democracy that have historically had a strong foothold in Nordic societies. They should be held on to, especially amidst the current controversial development taking place in cities.

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